Mexican data for July, 1901.

Stations.	Altitude.	Mean barometer.*	Temperature. Max.	Temperature. Min.	Temperature. Mean.	Relative humidity.	Precipitation.	Prevailing direction. Wind.	Prevailing direction. Cloud.
	Feet.	*Inch.*	*° F.*	*° F.*	*° F.*	*%*	*Inch.*		
Culiacan Ros. (Sin.)..	112	29.60	104.0	77.8	87.4	70	5.22	ssw.,sw.	ne.
Durango (Seminario)	6,243	23.94	102.7	51.8	71.8	54	1.78	ese.	e,
Leon (Guanajuato)...	5,906	24.21	88.3	56.3	70.2	67	3.18	se,	e.
Linares (Nuevo Leon).	1,188	28.60	96.8	68.0	81.9	72	1.38	s.	s.
Mazatlan	25	29.79	89.2	75.0	82.8	78	13.46	nw.	e.
Mexico (Obs. Cent.)..	7,472	22.99	76.1	52.7	62.2	72	6.90	n.	....
Morelia (Seminario)..	6,401	23.89	76.8	51.6	62.4	82	12.37	se.	e.
Puebla (Col. Cat.)...	7,125	23.32	78.3	53.6	66.0	70	6.52	ene.	ssw.
Saltillo (Col. S. Juan).	5,399	24.73	86.0	59.0	70.7	75	5.47	n.	ne.
S. Isidro (Hac. de Gto)	......	......	78.4	68.0	......	......	4.83	ne,	....
Toluca	8,812	21.91	72.9	36.5	58.5	74	5.94	s.	....

*Reduced to standard temperature and gravity.

SUPPLEMENTARY REMARKS ON THE THEORY OF THE FORMATION OF RAIN ON MOUNTAIN SLOPES.[1]

By Prof. Dr. F. POCKELS.

(1.) Assuming the average vertical distribution of temperature and moisture for each of the four seasons of the year as it is deduced by von Bezold from the scientific balloon ascensions published by Berson and Assmann in their "Ergebnissen," "The results of scientific balloon voyages," there result the following minimum elevations required in order that condensation may begin in a mass of air that was originally at the absolute altitude *H* above sea level.

H.	Spring-time.	Summer.	Autumn.	Winter.
Meters.	*Meters.*	*Meters.*	*Meters.*	*Meters.*
0	725	850	405	400
500	485	710	615	760
1,000	855	570	600	1,070
1,500	890	680	835	1,140
2,000	9[illegible]0	780	1,180	1,100
3,000	830	1,060	1,208	1,130
4,000	700	1,125	1,240	1,100

The smallest number in each colums is also the smallest altitude that a mountain ridge must possess in order to cause the formation of clouds under the assumed conditions, but it is only in the case of a very broad mountain ridge that such small altitude will suffice. We see that in the autumn and winter a mountain of about 400 meters in height will suffice to produce a formation of cloud in contact with the summit of the mountain, whereas in spring and summer, the mountain must be higher (namely about 500 or 570 meters respectively), and when the air passes over this mountain the formation of cloud will begin in the layer lying at 500 or 1,000 meters above its summit. These numbers at present serve only as examples; in practice, however, they suggest that as soon as we observe the formation of cloud above a mountain of less altitude than the above given tabular minimum altitude, we may conclude somewhat as to the average moisture at that altitude at that time. We may also remark that on account of the increasing flatness of the lines of flow as the altitude increases, the above given minimum altitudes must be exceeded by so much the more in proportion as the width of the summit ridge is smaller, and the altitude of the layer in which the condensation begins is higher.

(2.) The method developed by me for computing the condensation that occurs on any given mountain slope can not be applied to computing the mean value of the precipitation for any given interval of time, by introducing into the computation the mean values of the temperature and moisture for this interval. We should in this way find too small a precipitation. Thus, for example, the altitude of the mountains might not suffice to cause any condensation at all for the average condition of the air, but could cause it on those occasions when the moisture exceeds its average value, wherefore the average value of the rainfall for the interval of time under consideration would be different from zero. As the variation of the moisture from its average value may cause rainfalls where otherwise there would be none, so also, with the currents of air mechanically forced to ascend mountain ranges, and whose effect is superposed upon that of the general circulation of the air in cyclonic areas; for it can happen that neither one of these two causes may alone suffice to form rain, but that both together do. This explains why elevations of the surface of the earth of from 100 to 200 meters increase the annual mean value of the total precipitation, as for instance, as shown by the charts in Assmann's memoir of 1886, "Einfluss, etc." "On the influence of mountains on the climate of central Germany."

(3.) The examples given in my article show that in so far as condensation in general takes place on the slopes of mountains, its intensity (therefore also, the density of the precipitation when falling vertically) is in general greatest where the slope of the mountain is steepest. If now we consider that in the course of all the various conditions of the atmosphere that may occur in a long interval of time, the first condensation occurs most frequently above the upper portion of the slope, then it follows that the average density of precipitation computed for a long interval of time, must increase, not only with the inclination of the slope, but also with the absolute altitude of the locality under consideration. To this case corresponds the formula for the annual quantity of precipitation expressed in milimeters deduced by Dr. R. Huber in his "Untersuchungen, etc." investigation of the distribution of precipitation in the canton of Basle, namely:

$$N = 793 + 0.414\,h + 381.6 \tan \alpha$$

where h is the altitude in meters, and α indicates the gradient angle. (See A. Riggenbach, Verhandlung der Naturforschenden Gesellschaft. Basel, 1895. Vol. X, p. 425).

(4.) From a comparison of the effects of different broad mountain ranges of the same altitude, it results (see page 474 of my article, or page 157 of the translation in the MONTHLY WEATHER REVIEW) that the smaller, and therefore steeper, mountains always cause a smaller total condensation than the broader and narrower mountain summits. Notwithstanding this, the density of precipitation on the slope of the smaller is generally larger than on the slope of the larger mountains because the smaller total precipitation is distributed over a ground surface that is relatively much smaller yet. In reality, however, this only obtains so long as the quantity of water remaining suspended in the cloud is only a small fraction of the total condensation; in the case of very narrow mountain ridges it will be more apt to happen that a considerable fraction passes on over and beyond the summit and is subsequently again evaporated [and therefore does not appear as rainfall].

(5.) I regret to notice that in the first two figures of my original memoir, as also in the translation, the legend inscribed on the curves representing the distribution of precipitation reads "precipitation in millimeters per second," instead of "per hour," as is correctly stated in the text; the necesary correction should be made.

(6.) A precise test of this theory can not at present be carried out, because we have not sufficient observations of the

[1] The translation of the important memoir by Professor Pockles, of Heidelberg, published on pages 152–159 of the MONTHLY WEATHER REVIEW for April, 1901, was prepared and published quite promptly, without waiting for any subsequent corrections and notes by the author. A modified draft of the original memoir was published in the Meteorologische Zeitschrift for July, 1901, and Professor Pockles now requests that the following additional remarks may be published.

conditions of the upper strata and of the ground along the slope of a given mountain range.

[A special series of observations for this purpose could advantageously be made by means of kites and balloons determining the exact conditions that prevail in the great westerly currents that bring steady rain to the coasts of Oregon and Washington, or in the easterly currents that bring rain to the Atlantic States and the Appalachian Range. The kite work done by the United States Weather Bureau in 1898, in the upper Mississippi watershed and Lake region, affords excellent examples for the application of general theorems of the circulation of the upper atmosphere, but do not happen to illustrate the great problem of the formation of general rains on mountain slopes.—ED.]

MONTHLY STATEMENT OF AVERAGE WEATHER CONDITIONS FOR JULY.

By Prof. E. B. GARRIOTT, U. S. Weather Bureau.

The following statements are based on average weather conditions for July, as determined by long series of observations. As the weather for any given July does not conform strictly to the average conditions, the statements can not be considered as forecasts.

July is usually a quiet month on the North Atlantic Ocean. The storms of the middle latitudes are seldom severe, and the season of tropical hurricanes does not begin until August. July and August are the months of greatest fog frequency near the Banks of Newfoundland, and fog areas will be encountered in that region on fully two-thirds of the days of these months. The fogs of the Grand Banks and those of the steamer tracks to the westward usually occur with winds from the southeast quadrant. The southward movement of Arctic ice over the Banks of Newfoundland continues during July. Iceburgs do not, however, run so far south as during the spring months.

The general storms of the United States commonly originate on the middle-eastern or northeastern slope of the Rocky Mountains and move eastward over the northern Lake region, the St. Lawrence Valley, and Newfoundland without developing marked intensity. In the Pacific coast districts July and August are practically rainless months, and these are the driest months of the year in the middle and northern Plateau regions. In Arizona and New Mexico July and August are the wettest months of the year. From the Rocky Mountains to the Atlantic coast the heaviest monthly rainfalls of the year occur from June to August, and, as a rule, the greater part of the rain falls in showers or thunderstorms of short duration.

The frosts of July are confined, practically, to the northern tier of States and to mountain districts.

HAWAIIAN CLIMATOLOGICAL DATA FOR JULY, 1901.

By CURTIS J. LYONS, Territorial Meteorologist.

Meteorological observations at Honolulu, July, 1900.

The station is at 21° 18′ N., 157° 50′ W.

Hawaiian standard time is 10^h 30^m slow of Greenwich time. Honolulu local mean time is 10^h 31^m slow of Greenwich.

Pressure is corrected for temperature and reduced to sea level, and the gravity correction, —0.06, has been applied.

The average direction and force of the wind and the average cloudiness for the whole day are given unless they have varied more than usual, in which case the extremes are given. The scale of wind force is 0 to 12, or Beaufort scale. Two directions of wind, or values of wind force, or amounts of cloudiness, connected by a dash, indicate change from one to the other.

The rainfall for twenty-four hours is measured at 9 a. m. local, or 7.31 p. m., Greenwich time, on the respective dates.

The rain gage, 8 inches in diameter, is 1 foot above ground. Thermometer, 9 feet above ground. Ground is 43 feet, and the barometer 50 feet above sea level.

Date.	Pressure at sea level.	Temperature.		During twenty-four hours preceding 1 p. m., Greenwich time, or 2.29 a. m., Honolulu time.									Total rainfall at 9 a. m., local time.
				Temperature.		Means.		Wind.		Average cloudiness.	Sea-level pressures.		
		Dry bulb.	Wet bulb.	Maximum.	Minimum.	Dew-point.	Relative humidity.	Prevailing direction.	Force.		Maximum.	Minimum.	
	*	†	†			‡	‡		§				
1	29.92	76	69	84	74	66.3	68	ne.	3	3	29.95	29.90	0.04
2	29.98	76	69	85	74	65.5	64	ne.	3–4	4	30.01	29.93	0.00
3	29.97	77	69.5	83	74	65.0	63	ne.	4–3	5	30.02	29.96	0.00
4	29.94	77	70.5	84	75	67.3	67	ne.	4–5	4	29.98	29.93	0.00
5	29.94	75	69	85	75	67.5	68	ne.	5–4	3–7	29.96	29.90	0.02
6	29.96	69	67.5	84	74	66.7	70	ne.	3–4	6	29.98	29.91	0.01
7	29.98	69	68.3	84	68	68.7	83	sw-n.	1–0	3–9	30.06	29.96	0.42
8	30.01	76	69.5	85	68	68.0	75	ne.	1–3	2	30.04	29.99	0.01
9	29.97	76	68	85	73	65.7	64	ne.	3	3	30.03	29.94	0.00
10	29.95	77	71	85	75	65.0	63	nne.	3–4	3–5	29.99	29.94	0.02
11	30.00	76	68	84	74	67.3	67	ne–nne.	5	4–1	30.03	29.94	0.02
12	29.97	77	67	82	72	64.0	64	ne.	6–5	3–9	30.04	29.96	0.02
13	29.95	75	69	82	75	64.7	63	ne.	4–6	5	30.02	29.93	0.23
14	29.96	77	69	83	72	66.3	67	ne.	4–5	6–3	30.01	29.94	0.01
15	29.95	74	70.5	85	75	66.3	67	ne.	3	3–5	30.00	29.94	0.06
16	29.96	74	68	84	71	67.3	72	ne.	2–4	3	30.02	29.94	0.03
17	29.94	76	68.5	85	73	66.0	66	ne.	3	6	30.00	29.93	0.01
18	29.98	75	68.5	85	74	65.3	68	ne.	3	2	30.01	29.93	0.14
19	29.99	76	72	84	70	66.7	68	ne.	3–5	4	30.03	29.96	0.10
20	30.00	76	71	84	73	70.3	79	ne.	4	4–8	30.06	29.99	0.06
21	29.98	76	69.5	84	73	67.7	69	ne.	4	6–2	30.03	29.96	0.00
22	29.96	75	69	84	74	65.7	64	ne.	3	2	30.01	29.96	0.01
23	29.92	69	67	84	74	66.7	70	ne.	4	6	29.99	29.91	0.01
24	29.89	71	69	84	68	66.0	71	ne.	3	3	29.95	29.89	0.05
25	29.93	68	66.7	80	69	67.5	77	ne.	2–0	6–10	29.96	29.88	0.04
26	29.94	76	68	85	67	66.7	71	ne.	2–3	3	29.99	29.92	0.01
27	29.96	76	69.5	83	74	65.7	64	ne	4	5	29.98	29.91	0.00
28	29.94	76	68	84	75	66.7	71	ne	5–2	5	29.99	29.91	0.05
29	29.95	76	69	84	74	64.7	63	ne.	4–2	3	29.98	29.89	0.01
30	29.94	75	68.5	84	75	64.0	61	ne.	4	4	30.00	29.93	0.01
31	29.94	75	68	83	74	64.0	62	ne.	3–4	3–4	29.99	29.93	0.12
Sums..	......	......	......	......	......	......	......	....	......	......	......	......	1.53
Means.	29.957	74.7	68.9	83.9	72.7	66.2	68	....	2.7	4.4	30.004	29.933	......
Departure..	—0.026	......	......	......	......	+1.1	+1.2	....	......	+0.4	......	......	—0.27

Mean temperature for July, 1901 (6+2+9)÷3=77.8°; normal is 77.3°. Mean pressure for July (9+3)÷2 is 29.969; normal is 29.995.

GENERAL SUMMARY FOR JULY, 1901.

Temperature mean for the month, 77.8°; normal, 77.3°; average daily maximum, 83.9°; average daily minimum, 72.7°; average daily range, 11.2°; greatest daily range, 18°; least daily range, 7°; highest temperature, 85°; lowest, 67°.

Barometer average, 29.969; normal, 29.995 (corrected for gravity by —.06); highest, 30.06, on the 19th; lowest, 29.88, on the 24th; greatest 24-hour change, .08. On account of the evenness of pressure, lows and highs were hardly distinguishable; low pressure may be noted on the 4th and 24th, and high on the 11th and 19th. The barometer has been below the normal for four months in succession.

Relative humidity, 68; normal, 66.8; mean dew-point, 66.2°; normal, 65.1°; mean absolute moisture. 7.07 grains to the cubic foot; normal, 6.81.

Rainfall, 1.53 inch; normal, 1.80 inch; rain recorded days, 25; normal, 19; greatest rainfall in one day, 0.42 inch, on the 6th; total at Luakaha, 8.75 inches; at Kapiolani Park, 1.10 inch; at Kalihi-uka, 2.50 inches fell on the 6th. Total rainfall since January 1, 22.94 inches; normal, 20.62 inches.

The artesian well water stands at 33.40 feet above mean sea level at the Punahou well. The average mean sea level for the month stood at 10.42 feet above an assumed base, 9.00 feet being hydrographic zero (low water) and 10.00 feet standard mean sea level.

Trade-wind days, 30 (1 of north-northeast); normal for July, 29; average force, Beaufort scale, 2.7 (16 statute miles per hour). Cloudiness, tenths of sky, 4.4; normal, 4.0. Upper currents of air mostly from the southwest.

Percentages of district rainfall as compared with normal: Hilo, 40 per cent; Hamakua, 17; Kohala, 20; Waimea, 14; Kona, 125; Kau, 50; Puna, —; Maui, probably 100; Oahu, 100; Kauai, 250 to 320. The lack of water in North Hawaii is quite serious.